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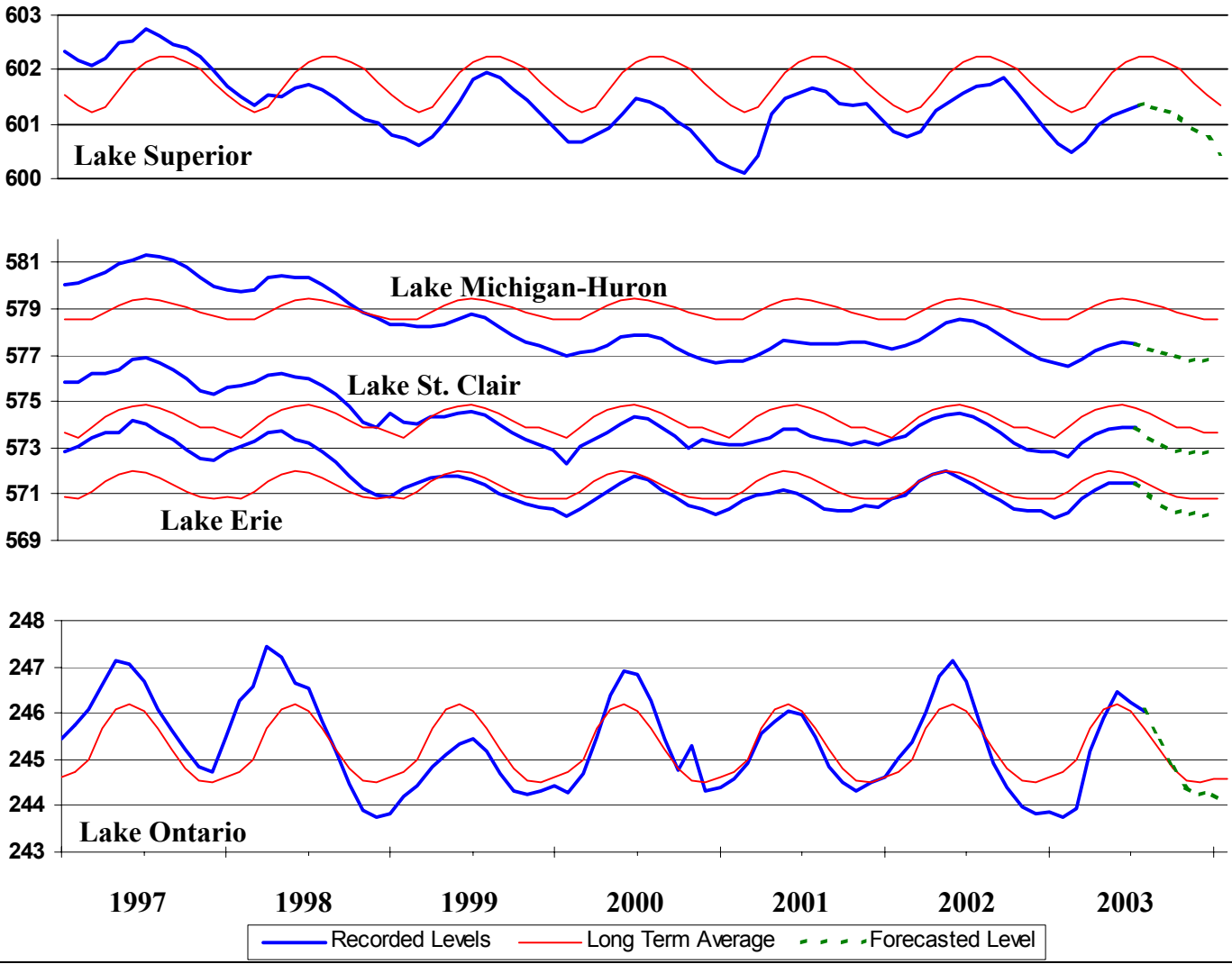
Great Lakes Update

Frequently Asked Questions on Current Water Levels

Over the past several years, Great Lakes water levels have undergone dramatic changes. In the first half of 1997, levels on the upper Great Lakes were near record highs. In contrast, in September 2003 Lakes Superior and Michigan-Huron were only 15 cm (6 inches) and 18 cm (7 inches), respectively, above the record low monthly mean for each lake. Many factors have contributed to this decline in water levels including precipitation patterns, evaporation, and snow pack. This update article addresses several key questions that we frequently receive regarding current water level conditions.

Great Lakes Water Levels - January 1997 through February 2004



What are the current conditions and what is expected over the next several months?

Water levels on the upper Great Lakes continued their below-average trend in 2003. A greater-than average fall-winter decline in late 2002/early 2003 set up conditions for lower water levels in the summer of 2003 on Lakes Superior, Michigan-Huron, and St. Clair. Lake Erie levels were closer to average in 2003 due to above average precipitation in late spring.

For the remainder of 2003, water levels on Lakes Superior, Michigan-Huron, and St. Clair are expected to remain low--significantly below the long-term average (LTA). Lake Erie is expected to slip further away from long-term average throughout the year; Lake Ontario is currently just above LTA and is expected to dip below average in the next month.

Have the water levels ever been this low?

Yes, water levels have been this low and lower several times since the current network of water level gages began operation in 1918. Levels on Lake Superior have been lower than this past month's level three times since 1918, with the record low occurring in 1926. Lake Michigan-Huron was lower than September 2003 four times since water levels have been recorded; the record low occurred in 1964. Both Lakes St. Clair and Erie were lower in 2001 than this September; however, the last time that levels were this low prior to 2001 was in the period from 1963 to 1966. The record low on both Lakes St. Clair and Erie occurred in 1934.

What role has precipitation played in the decrease in water levels?

Precipitation and surface water runoff (which is driven by precipitation) play a key role in influencing water levels of the Great Lakes. The influence is greater the further upstream in the system you go. For example, precipitation and runoff account for 96 percent of the water volume entering Lake Superior on an average annual basis. Precipitation and runoff account for 71 percent of the water volume entering Lakes Michigan-Huron. This factor is only 22 percent in Lake Erie and 20 percent in Lake Ontario.

Over the past six years, there have been times that precipitation has been below average for several months in a row. However, precipitation for the Lake Superior and Michigan-Huron basins have been near average overall from 1997 to 2003.

Probably more important than the annual precipitation values is the amount of precipitation that has fallen as snow. Snowmelt in the spring drives the seasonal rise on Lake Superior and thus has a significant impact on water levels throughout the rest of the Great Lakes basin. In 1998 and 2000, snow water equivalent over the Lake Superior basin was 27 percent and 71 percent below average, respectively. The seasonal rise following these two low-snow winters was less than average, as expected. The lack of snowfall has contributed to the decline in water levels over the past six years.

How significant is evaporation on the Great Lakes?

Water that has entered the Great Lakes has two ways to exit—leaving as outflows from each of the Great Lakes (such as the St. Clair River outlet from Lake Huron) or through evaporation. Evaporation is a very significant component, especially in the upper lakes. For Lake Superior, 40 percent of the water volume exiting the lake leaves through evaporation and 60 percent leaves through the St. Marys River. On Lakes Michigan-Huron, evaporation accounts for 31 percent of the water losses, with the remaining 68 percent exiting through the St. Clair River and 1 percent through the Chicago Diversion.

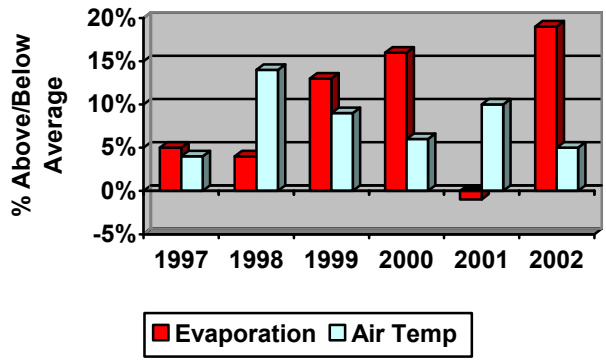
Maximum evaporation occurs when the Great Lakes water temperatures are much warmer than

the air moving across them. This situation occurs primarily in the fall and early winter.

Air temperatures in the Great Lakes region have been significantly above average since 1998. Because air temperatures have been above average, water temperatures have also been above average. Warmer water temperatures at the end of summer can produce increased evaporation, which is what has occurred in the past six years.

As shown in the figure below, air temperatures around Lake Superior have been above average in five out of the last six years. As expected, evaporation has also been significantly above average due to the warming trend across the basin.

Lake Superior



As demonstrated in the tables below, years with above average evaporation on Lakes Superior and Michigan-Huron also have an above average seasonal water level declines.

Lake Superior

Year	Evaporation (% average)	Seasonal Decline (% average)
1997	105	139
1998	104	113
1999	113	126
2000	116	135
2001	99	90
2002	119	132

Lake Michigan-Huron

Year	Evaporation (% average)	Seasonal Decline (% average)
1997	90	166
1998	103	231
1999	110	183
2000	105	124
2001	84	38
2002	107	207

All of the Great Lakes typically undergo a seasonal decline from August to February. The tables illustrate that above average evaporation generally leads to seasonal water level declines that are greater than average. Several consecutive years of above average declines have contributed to the long-term declining water level trend on the Great Lakes.

What effect does ice cover have on water levels?

It is clear that water temperature and evaporation play a significant role in the rise and fall of water levels on the Great Lakes. When there is little or no ice cover, evaporation can continue through the winter. However, the majority of evaporation occurs in the fall and early winter when the temperature difference between the air and water is the greatest. Therefore, a lake with considerable ice cover does not significantly reduce annual evaporation.

A significant ice cover can offer some benefits, however. While the ice will not cause an immediate increase in water levels or foretell a higher summer peak level, significant ice cover can affect water temperatures. A benefit of a significant ice cover this year, in addition to the rather cool spring and summer, is that the water temperatures in the Great Lakes were lower than they have been in the past few years. Evaporation may be less of a factor this fall because of the cooler water temperatures.

Where are the diversions and how much can they affect Great Lake water levels?

The major diversions in the Great Lakes basin that affect water levels to a measurable extent are: (1) diversions into Lake Superior at Long Lac and Ogoki; (2) a diversion out of Lake Michigan at Chicago; and (3) a diversion between lakes Erie and Ontario through the Welland Canal. These diversions have a minor effect on water levels compared to natural factors and regulation of Lakes Superior and Ontario.

The average annual flow rate into Lake Superior from the Long Lac and Ogoki diversions is 150 cms (5,300 cfs). These diversions, entirely in the Province of Ontario, were authorized between the United States and Canada in 1940. The flow through the Lake Michigan diversion at Chicago is 91 cms (3,200 cfs) and the flow from Lake Erie to Lake Ontario through the Welland Canal is 221 cms (7,800 cfs). This compares to the average outflow of 2,140 cms (76,000 cfs) from Lake Superior, 5,200 cms (184,000 cfs) from Lake Michigan-Huron at Port Huron, Michigan, 5,710 cms (202,000 cfs) from Lake Erie through the Niagara River, and 6,870 cms (243,000 cfs) from Lake Ontario.

Great Lakes Diversions

According to a 1985 report by the IJC, these diversions alter the supply of water to the Great Lakes, resulting in changes to water levels. The long-term effect has been to increase the mean water levels on Lake Superior by 2.5 cm (1 inch) and decrease Lake Michigan-Huron by 0.5 cm (0.25 inches).

Could the Chicago Diversion be decreased to keep more water on Lake Michigan-Huron?

Generally, no, the amount of water diverted at Chicago is a small fraction of the outflow from Lakes Michigan-Huron. The Chicago Diversion represents only one percent of the water volume leaving Lakes Michigan-Huron on a daily basis. The majority of water exits the system through the St. Clair River. Also, any decrease would require significant changes in institutional arrangements and would generate significant environmental consequences.

Water from Lake Michigan and its drainage basin is diverted into the Des Plaines River, a tributary of the Illinois River and a part of the Mississippi River drainage basin. The Lake Michigan Diversion has an average flow rate of 91 cms (3,200 cfs), which is managed in accordance to U.S. Supreme Court decrees. The diversion has been below this rate, however, since 1994. For comparison, the average flow in the St. Clair River is 5,710 cms (184,000 cfs).

It is also important to note that the diversions into the basin from Long Lac and Ogoki are greater than the diversion out of the basin at Chicago.

Summary

This article summarizes current conditions and discusses some of the key factors that have contributed to current low Great Lakes water levels. An increase in water temperatures, which led to increased evaporation, is one of the main factors that has produced the lower water levels. A sustained increase in precipitation and decrease in evaporation will be needed before significant improvement occurs to water levels on the upper Great Lakes.